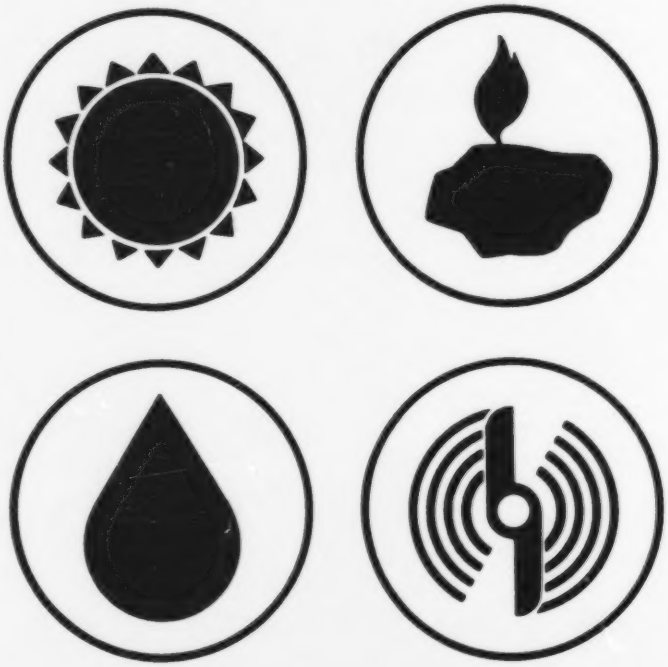
ALBERTA/CANADA ENERGY RESOURCES RESEARCH FUND

Sixth Annual Report
April 1, 1981 - March 31, 1982

ISSN 0225-3607
ISBN 0-86499-065-0



Alberta
ENERGY AND
NATURAL RESOURCES

Canada
ENERGY, MINES AND
RESOURCES

International Standard Series Number 0225-3607
International Standard Book Number 0-86499-065-0
Energy and Natural Resources Report Number I 9 — 81 82

Additional copies of this report are available from:

Alberta Energy and Natural Resources
Publications Section
Resource Information Services
14th Floor, South Petroleum Plaza
9915 - 108 Street
Edmonton, Alberta, Canada
T5K 2C9

Phone: (403) 427-7003

Aussi disponible en français; s'adresser à:

Energie, Mines et Ressources Canada
580 rue Booth
Ottawa, Ontario, Canada
K1A 0E4

To:

The Honourable Merv Leitch
Minister of Energy and Natural Resources
Edmonton

The Honourable Jean Chretien
Minister of Energy, Mines and Resources
Ottawa

Sirs:

We have the honour to present the Sixth Annual Report relating to the ALBERTA CANADA ENERGY RESOURCES RESEARCH FUND AGREEMENT for the fiscal year ending March 31, 1982.

Respectfully submitted,

Dr. K. Whitham
Co-Chairman, Alberta Canada
Energy Resources Research Fund

Dr. G.B. Mellon
Co-Chairman, Alberta Canada
Energy Resources Research Fund

CONTENTS

Highlights 1
Background 2
Alberta Canada Committee 3
Program Objectives and Guidelines 4
Approved Projects 5
Financial Statement 35

HIGHLIGHTS

The Sixth Annual Report summarizes activities conducted under the terms of the Alberta Canada Energy Resources Research Fund for the period April 1, 1981 to March 31, 1982. During this time, the Fund supported 18 energy-related research and development projects and the design and construction of a new coal research facility at Devon.

Following are the highlights from the year's activities:

- The preliminary design of a delta-blade wind turbine system suitable for direct water pumping applications, and a comparative study of various wind turbines confirmed the technical feasibility and competitiveness of the delta-blade turbine compared with currently available electric generator wind turbine systems.
- Potential fuel savings of approximately six percent were identified by attaching streamlining tailcones on tractor-trailers.
- An energy audit of the natural gas industry shows that approximately six percent of the natural gas produced is consumed in processing and pipelining the gas, and that significant savings may be possible.
- Detailed laboratory studies on carbon dioxide, sulphur dioxide, and hydrocarbon gas flooding techniques for enhanced oil recovery progressed to a stage that will facilitate the choice of an appropriate recovery method for the Snipe Lake Oil Field.
- The Computer Modelling Group improved existing models, developed new, more efficient numerical techniques, and extended its service capability to industry within Canada and abroad.
- A basic handbook of geophysical borehole logging techniques for coal exploration was completed. Other work concentrated on research into mining techniques and the implications of moisture and mineral content on the beneficiation of Alberta coals. The Alberta Research Council obtained information regarding the evaluation and characterization of Alberta coal. Promising process conditions for the conversion of coal into liquid fuels have been identified.
- A new analytical technique using field ionization mass spectrometry led to the discovery of a new class of marker compounds, the sulphoxides, in Alberta heavy oils.

Detailed information on these and other projects is provided in the section entitled "Approved Projects".

BACKGROUND

The Alberta Canada Energy Resources Research Fund was created as a result of the March 1974 oil-pricing agreement between the producing provinces and the federal government.

To minimize the economic impact of crude oil price increases in Canada, it was agreed to hold the wellhead price of domestic crude oil at $6.50 barrel from April 1, 1974 to June 30, 1975. In recognition of Alberta's agreeing to sell its crude oil below international prices, the federal government committed to provide increased funds to assist Alberta in strengthening and diversifying its economy.

The money eventually amounted to a federal commitment of $144 million with $96 million to be directed to energy-related research projects over a six-year period, starting with a transfer of funds in the 1976 77 fiscal year.

Following an exchange of letters between the Prime Minister of Canada and the Premier of Alberta in October and November 1976, agreement was reached on the terms of reference of the Alberta Canada Energy Resources Research Fund. The responsibility of applying and administering the Fund was assigned to the Alberta Canada Committee made up of senior Alberta and federal officials.

ALBERTA/CANADA COMMITTEE

The Prime Minister of Canada and the Premier of Alberta agreed upon the following terms for the operation of the Alberta Canada Committee:

i) The Committee will consist of three senior officials from each of the Alberta and federal governments;

ii) Based upon proposals made by or acceptable to Alberta, the Committee will agree in principle on the broad scope of a long-term energy research program to be carried out;

iii) The Committee will meet annually to review progress and to agree upon the energy-related projects that will make up the research program for the one-year period immediately ahead. A review of the previous year's progress will also be made;

iv) Once agreement has been reached on the list of projects for the one-year period immediately ahead, arrangements will be made by the federal government to transfer to the Alberta government the block of funds for the year in question. Where the Committee has, in its annual review, included a project on the list after considering a detailed proposal, Alberta will be free to pass the required funds from the block directly to the Alberta department or agency responsible for the project. Where the Committee does not have available, at its annual review, the detailed proposal concerning any project included in the list, funds pertaining to that project will be retained by Alberta in a special account until the Committee has been able to review and agree upon a detailed proposal. (It would be accepted that review and agreement in such cases might well be achieved through correspondence.);

v) With respect to the research projects carried out, results will be incorporated in reports recording the data and concepts developed, and such reports will be fully available to the Alberta and federal governments.

On March 31, 1982 the Alberta Canada Committee members were:

ALBERTA

— Dr. G. B. Mellon (Co-Chairman), Deputy Minister, Energy and Natural Resources
— Dr. C. W. Bowman, Chairman, Alberta Oil Sands Technology and Research Authority
— Mr. R. D. McDonald, Executive Director, Scientific and Engineering Services, Energy and Natural Resources

CANADA

— Dr. K. Whitham (Co-Chairman), Assistant Deputy Minister, Research and Technology; Energy, Mines and Resources
— Dr. P. J. Dyne, Director General, Office of Energy Research and Development; Energy, Mines and Resources
— Dr. J. H. Walsh, Senior Special Advisor, Coal, Conservation and Non-Petroleum Sector; Energy, Mines and Resources.

PROGRAM OBJECTIVES AND GUIDELINES

The Alberta Canada Energy Resources Research Fund has two basic objectives:

- to promote and support research into the development and efficient use of Alberta's existing and potential energy resources, having regard for the province's and Canada's medium and longer-term energy needs, and
- to encourage the development of Alberta-based scientific and technical expertise in the field of energy research and development.

Proposals for specific research projects are reviewed and assessed within the context of the following program guidelines:

1. The Alberta Canada Energy Resources Research Fund program shall include research on both renewable and non-renewable (fossil fuel) resources, generally excluding, however, oil sands and conventional and heavy crude oil. Alberta government funding of research into the development and utilization of these important resources is carried out through a Crown agency, the Alberta Oil Sands Technology and Research Authority (AOSTRA).
2. Eligible research projects shall include those relating to exploration, production, transportation, conservation, and utilization of Alberta's energy resources.
3. Preference will be given to applied or mission-oriented research projects, although some consideration will be given to funding of appropriate basic research projects.
4. An attempt will be made to develop a reasonably wide spectrum of projects with prospects for both short- and longer-term benefits.
5. Consideration will be given, under certain circumstances, to proposals for construction of new or improved physical facilities for energy-related research in Alberta.
6. To the most practical extent possible, preference will be given to projects utilizing Alberta-based scientific and engineering expertise.
7. The Alberta-based private sector will be encouraged to participate directly in the program, through submission of appropriate research proposals and through representation on specific project management and technical advisory committees.
8. Most approved projects will be carried out under a legal agreement between Alberta Energy and Natural Resources and the researchers, specifying the terms and conditions under which the research funds will be expended, and under which the technology will be disclosed, owned, and licensed.

Research proposals may be directed to: The Manager, Research Programs, Alberta Energy and Natural Resources, 9th Floor, South Petroleum Plaza, 9915 - 108 Street, Edmonton, Alberta T5K 2C9.

APPROVED PROJECTS

ENHANCED RECOVERY OF CONVENTIONAL CRUDE OIL

Contractor: Petroleum Recovery Institute, Calgary

Expenditures:

1981/1982	$ 550 000
Total to Date	$ 2 772 961

Objectives: To accelerate the Institute's research into improved recovery of conventional crude oil and to assess new enhanced recovery techniques with respect to Alberta crude oil reservoirs.

Results: Work carried out to date has included a wide range of engineering studies and laboratory test work relating to the prospects of improving oil recovery by flooding techniques involving steam, carbon dioxide, sulphur dioxide, hydrocarbon gases, and chemicals known as surfactants and polymers.

During 1981 82, further detailed laboratory studies on carbon dioxide, sulphur dioxide, and hydrocarbon gas flooding were conducted and the results applied to an engineering study of a recovery scheme for the Beaverhill Lake Pool of the Snipe Lake Oil Field.

Engineering studies to determine the potential of polymer flooding techniques in the Lloydminster A pool were also completed.

Implications: It is believed that an additional 300 to 475 million cubic metres of oil could be recovered by tertiary enhanced recovery methods. This represents a potential increase of 40 percent of the remaining established conventional crude oil reserves in Canada.

Publications:

Batycky, J.P. *Laboratory Testing of Polymers for Field Applications.* Calgary: Petroleum Recovery Institute, 1981. (PRI 81-14)

Batycky, J.P.; Maini, B.B.; and Milosz, G. *A Study of the Application of Polymeric Gels in Porous Media.* Calgary: Petroleum Recovery Institute, 1982. (PRI 82-2) Also presented at SPE International Oilfield and Geothermal Chemistry Symposium; Dallas, Texas, January 1982.

Collins, H.N.; and Pilles, D. *Reconciliation of Porosity Interpretations in McLaren Sands Using Functional Analysis.* Calgary: Petroleum Recovery Institute, 1981 (PRI 81-11)

Collins, H.N.; De Bree, C.; Ito, Y.; Hayashitani, M.; Lim, T.; and Batycky, J.P. *Sweep Improvement Study — Chauvin South Sparky A & B Pool, Part II: Evaluation of Potential for Polymer Applications.* Calgary: Petroleum Recovery Institute, 1981. (PRI Field Report No. 2)

Collins, H.N.; and Pilles, D. "Benefits of Linear Bivariate Log Analysis Models". Paper presented at Eighth Formation Evaluation Symposium of Canadian Well Logging Society in Calgary, Alberta, September 1981 and 56th Annual Meeting of SPE in San Antonio, Texas, October 1981.

Fisher, D.B.; and Saraf, D.N. *A Photometric Method for Measuring Produced Fluids During Immiscible and Miscible Laboratory Displacement Tests.* Calgary: Petroleum Recovery Institute, 1982. (PRI 82-4)

Hayashitani, M.; Davis, W.; Novosad, J.; and Batycky, J.P. *Numerical Simulation of Laboratory Steamflood Experiments.* Calgary: Petroleum Recovery Institute, 1981. (PRI 81-1)

Hayashitani, M.; and Davis, W. *Provost Upper Mannville B Pool.* Calgary: Petroleum Recovery Institute, 1981. (PRI 81-7)

Li, Y.K.; Nghiem, L.X.; and Sayegh, S.G. *Phase Behavior Predictions of Oil-$C0_2$-$S0_2$ Mixtures Using the Peng-Robinson Equation of State.* Calgary: Petroleum Recovery Institute, 1982. (PRI 82-3)

Novosad, J. "Surfactant Retention in Berea Sandstone — Effects of Phase Behavior and Temperature". SPE Paper No. 10064 accepted for publication by the SPE Journal and presented at 56th Annual Meeting of SPE in San Antonio, Texas, October 1981.

Novosad, J. "Experimental Study and Interpretation of Surfactant Retention in Porous Media". *Proceedings of the 1981 European Symposium on EOR.* Lausanne: Elsevier Sequoia S.A. and presented to 1981 European Symposium on EOR in Bournemouth, England, September 1981.

Saraf, D.N.; and McCaffery, F.B. *Two- and Three-Phase Relative Permeabilities: A Review.* Calgary: Petroleum Recovery Institute, 1981. (PRI 81-8)

Saraf, D.N.; Batycky, J.P.; Fisher, D.B.; and Jackson C.H. *An Experimental Investigation of Three-Phase Flow of Water-Oil-Gas Mixtures through Water-Wet Sandstone.* Calgary: Petroleum Recovery Institute, 1982. (PRI 82-1) Also presented at SPE California Regional Meeting in San Francisco, California, March 1982.

Sayegh, S.G.; and McCaffery, F.G. "Laboratory Testing Procedures for Miscible Flooding". Paper presented at 1981 European Symposium on EOR in Bournemouth, England, September 1981. *Proceedings of the 1981 European Symposium on EOR.* Lausanne: Elsevier Sequoia S.A.

Sayegh, S.G.; Najman, J.; and Hlavacek, B. "Phase Equilibrium and Fluid Properties of Pembina Cardium Stock-Tank-Oil-Methane-Carbon Dioxide-Sulphur Dioxide Mixtures". *Journal of Canadian Petroleum Technology,* October-December 1981: 76-90

COMPUTER MODELLING TECHNOLOGY

Contractor: Computer Modelling Group, Calgary

Expenditures:

1981 82	$ 300 000
Total to Date	$ 2 294 188

Objectives: To develop expertise in mathematical and computer modelling based on data relating to the recovery of Alberta's fossil fuel resources.

Results: Substantial effort was directed towards optimization, addition of new user-oriented options, and development of new, more efficient numerical techniques for the Computer Modelling Group (CMG)'s programs. Significant advances were made in:

1) the multi-grid method of solving large systems of equations
2) chemical flood simulation
3) the efficient phase behaviour calculation method.

The other aspects of CMG's work are related to the utilization of its models in service projects for industry and the sale of its models to industry. Over the year, 14 companies used services provided by CMG, and CMG programs were sold to several companies in Canada and abroad.

Implications: CMG technology is making it possible for Canadian industry to improve the design of enhanced oil recovery schemes.

The need to import simulation technology to Canada has been substantially reduced.

Canada has become a significant exporter of simulation technology.

Publications:

Aziz, K. "Computer Modelling of EOR Processes." Paper presented at the 1981 European Symposium on Enhanced Oil Recovery, Bournemouth, England, September 1981.

Behie, A.; and Forsyth, P.A. Jr. "Multi-Grid Solution of the Pressure Equation in Reservoir Simulation." SPE 10492 presented at the Sixth SPE Symposium on Reservoir Simulation in New Orleans, Louisiana, February 1981. (MGR17-01)

Computer Modelling Group. *Progress Report and Plans.* Calgary: Computer Modelling Group 1981. (CMG.PR.07)

Computer Modelling Group. *Progress Report and Project Plans.* Calgary: Computer Modelling Group 1981. (CMG.PR.08)

Forsyth, P.A. Jr.; Rubin, B.; and Vinsome, P.K.W. "Elimination of the Constraint Equation and Modelling of Problems with a Non-Condensable Gas in Steam Simulation." Paper presented at the Annual General Meeting of the Petroleum Society of CIM in Calgary, Alberta (May 3-6, 1981). Also published in *Journal of Canadian Petroleum Technology*, Vol. 20, No. 4 (1981), 63-68.

Grabowski, J.W.; Rubin, B.; and Harding, T.G. "A Preliminary Numerical Simulation Study of In Situ Combustion in a Cold Lake Oil Sands Reservoir." *Journal of Canadian Petroleum Technology*, Vol. 20, No. 2 (1981), 79-89.

Ko, S.C.M.; Buchanan, W.L.; and Vinsome, P.K.W. "A Critical Comparison of Finite-Difference Interblock Mobility Approximations in Numerical Reservoir Simulation." Paper presented at the Annual General Meeting of the Petroleum Society of CIM in Calgary, Alberta (May 3-6, 1981). Also published in *Journal of Canadian Petroleum Technology*, Vol. 21, No. 2 (1982), 62-74.

Li, Y.K.; Nghiem, L.X. and Sayegh, S.G. *Phase Behavior Predictions of Oil-CO_2-SO_2 Mixtures Using the Peng-Robinson Equation of State.* Calgary: Computer Modelling Group, 1982. (CMG.RM.05)

Nghiem, L.X.; Fong, D.K.; and Aziz, K. "Compositional Modelling with an Equation of State." *Society of Petroleum Engineers Journal*, Vol. 21, No. 6 (1981), 687-698.

Nghiem, L.X.; Behie, A.; and Forsyth, P.A. Jr. "Fully Implicit Hydraulic Fracture Model." SPE 10506 presented at the Sixth SPE Symposium on Reservoir Simulation in New Orleans, Louisiana, February 1981.

Nghiem, L.X.; Forsyth, P.A. Jr.; and Behie, A. *A Fully Implicit Hydraulic Fracture Model.* Calgary: Computer Modelling Group, 1981. (CMG.R8.03)

Nghiem, L.X. "Modelling Infinite-Conductivity Vertical Fractures Using Source and Sink Terms." SPE 10507 presented at the Sixth SPE Symposium on Reservoir Simulation in New Orleans, Louisiana, February 1981.

Siu, A.L.; and Nghiem, L.X. *A Fully Implicit Model for Infinite-Conductivity Vertical Fractures.* Calgary: Computer Modelling Group, 1982. (CMG.R8.04)

COAL MINING RESEARCH

Contractor: Coal Mining Research Centre, Edmonton

Expenditures:

1981/82	$ 837 722
Total to Date	$ 2 245 646

Objectives: To research, develop and demonstrate new or improved coal mining and preparation technology for the extraction and beneficiation of western-Canadian coals.

Results: Work continues on the evaluation of the effectiveness of mine drainage measures and the assessment of reclamation-related incremental mining costs. A report has been prepared on the methods of, and requirements for, measurement and prediction of mining subsidence in the Lethbridge area. Continuing research also concentrates on the beneficiation of low-rank plains and foothills thermal coals, specifically on the removal of moisture and clay through thermal drying and dry cleaning techniques respectively. Foothills coals were tested using pilot commercial dryers. Moisture levels of Alberta coal samples were reduced from 20 percent to four percent. Commercially useful cleaning efficiencies have been achieved at the bench scale with the development of a counter-current fluidized bed cascade for dry cleaning.

Implications: Demands for Canadian coal forecast for the year 2000 indicate that metallurgical coal production must increase by two to three times, and thermal coal production by six to 13 times over that of 1977. Improved exploration technology will enhance the knowledge of coal reserves and lead to better mine design. Better mining technology will enhance coal recovery, reduce costs, increase safety and enhance reclamation. Improved coal preparation technology should reduce costs, increase resource recovery, decrease waste disposal problems and increase the marketability of coal for export.

Publications:

Barron, K. *Progress in the Mining Technology Research Program of the Coal Mining Research Centre,* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/16-T)

Beeckmans, J.M.; Gorannson, M.; and Butcher, S.G. "Coal Cleaning by Counter Fluidized Bed Cascade". *CIM Bulletin,* V. 75, #839, March 1982.

Butcher, S.G.; and Symonds, D.F. *A Review of Dry Cleaning Processes.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/32-T)

Butcher, S.G.; and Wright, P.L. *The Purpose and Practice of Coal Preparation in Canada.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/19-T)

Butcher, S.G. *Coal Mining Research Centre — Program and Facilities for Coal Preparation Research.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/50-T)

Butcher, S.G. *The Role of Coal Preparation in the Canadian Coal Industry.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/68-T)

Butcher, S.G. *Novel Techniques Applied to the Beneficiation of Western Canadian Coals.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/03-T)

Butcher, S.G. *Beneficiation of Western Canada's Low Rank Coals.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/18-T)

Chekerda, K.; Germain, R.; and Fawcett, D. *Compilation of Canadian Research Projects in Coal Exploration, Mining and Preparation.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/30-T)

Chopiuk, R.; and Chekerda, K. *Selective Materials Handling for Strip Mine Reclamation in the Ardley Coal Zone.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/19-T)

Coal Mining Research Centre. *Coal Mining Research Centre Annual Report 1980/81.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/42-T)

Coal Mining Research Centre. *Coal Mining Research Centre (Five Year Research Program).* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/22-T)

Grant, F. *An Evaluation of Underground Coal Mining Parameters of Former West Canadian Coal Mines for Future Mining Reference.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/17-T)

Germain, R.; and Hinds, J. *A Review of Standards for Coal Moisture Determination.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/37-T)

Germain, R.; Butcher, S.G.; and Beeckmans, J.M. *Dry Cleaning of Coal in the Counter Current Fluidized Cascade.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/06-T)

Norwest Resources Consultants Ltd. *A Review of Dry Cleaning Processes.* Prepared for CMRC, Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/21-T)

Stimpson, B. *Development of the Base Friction Modelling Technique as a Visual Tool for Mine Safety Instruction.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/22-T)

Wright, P.L.; and Reid, H.W. *Diagnostic Maintenance Final Report for Task 79/10 and 80/06.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/26-T)

Wright, P.L. *Some Experiences of Production Extraction Related to the Direction of the Seam Inclination.* Edmonton: Coal Mining Research Centre, 1981. (CMRC 81/40-T)

Wright, P.L. *The Status of Investigation and Prediction of Mining Subsidence in the Lethbridge Area.* Edmonton: Coal Mining Research Centre, 1982. (CMRC 82/07-T)

Zeindler, R.W., and Fawcett, D.A. "Application of a Cross Pit Conveyor System in Mining." *CIM Bulletin,* V. 74, #838, April 1981.

ALBERTA UNIVERSITIES PROGRAM

Contractor: Universities of Alberta, Calgary, and Lethbridge

Expenditures:

1981/82	$ 619 023
Total to Date	$ 1 792 636

Objectives: To encourage research on Alberta's fossil fuel and renewable energy resources by Alberta universities staff.

Results: Of the 14 active projects previously selected and/or renewed for funding, seven were completed and reports prepared:

Dr. F.W. Jones, University of Alberta: Investigation of Geothermal Energy Resources of Alberta.

Dr. J.W. Costerton, University of Calgary: Control of Energy Losses by Microbial Fouling of Heat Exchangers in Thermal Energy Recovery Operations.

Dr. T. Chivers, University of Calgary: Production of Hydrogen and Sulphur from Thermal Decomposition of Hydrogen Sulphide Assisted by Metal Sulphides.

Dr. H.A.K. Charlesworth, University of Alberta: Structure of the Coal-Bearing Strata Near Cadomin, Alberta.

Dr. L.C. Nkemdirim, University of Calgary: Atlas of Solar Energy for Alberta.

Dr. G.A. Karim, University of Calgary: Effective Utilization of Low Heating Value Fuels.

Dr. E.L. Tollefson, University of Calgary: Development of a Process for Production of Activated Carbon from Coal.

In addition, two projects were completed and reports are in preparation.

Dr. L.R. Plitt, University of Alberta: Modelling and Control of Coal Beneficiation Unit Operations.

Dr. K.C. Cheng, University of Alberta: Application of Boiling and Condensation Heat Transfer to Flat Plate Solar Collectors in Cold Regions.

One project was renewed for a second year of funding:

Dr. C.M. Rodkiewicz, University of Alberta; Dr. B. Ignasiak, Alberta Research Council: Beneficiation and Transport of Mined Coal;

and one project was renewed for a third year of funding:

Dr. A.A. Offenberger, University of Alberta: High-Power Krypton Fluoride Laser System for Fusion Energy Research.

Six projects have been selected for funding from 12 applications in fiscal year 1981 82. Four projects are related to energy conservation and renewable energy research and two projects involve research on conventional energy resource assessment.

Dr. F.W. Jones, University of Alberta: A Detailed Study of Regions of Geothermal Energy Potential in Alberta.

Dr. J. Toth, University of Alberta: Investigation of the Relation Between Formation-Fluid Dynamics and Petroleum Occurrences in Taber Area, Alberta.

Dr. S.E. Hrudey, University of Alberta: Methanogenic Treatment of Phenolic Waste Waters.

Dr. J.W. Costerton, University of Calgary: Modification of the "Ice Nucleation" Technique to Produce a Practical Method for Defouling Heat Exchangers.

Dr. R.E. Rink, University of Alberta: Bilinear Controller for Solar Heating Systems.

Dr. D. C. Lawton, University of Calgary: Reflection Seismic Investigations of Western Canadian Coal Fields.

ENERGY CONSERVATION IN SOUR GAS PROCESSING

Contractor: Bow Valley Research Ltd., Calgary

Expenditures:

1981 82	$ 209 532
Total to Date	$ 918 574

Objectives: To develop improved technology for reducing energy consumption in processing natural gas.

Results: Work continued on the pilot-scale study of catalytic incineration of sulphur plant waste gases. While the operation of the unit was extremely stable, problems with construction materials required repairs that have delayed the testing program.

An energy audit of the Alberta natural gas industry was completed. The results showed that nearly six percent of the produced natural gas is consumed in processing and pipelining the gas.

The data showed that certain gas plant operations such as compression, process heating, steam generation and incineration consume much of the energy. By studying the energy-utilization efficiencies of various plants, it was estimated that up to 50 percent of the energy consumed in some plants might be saved.

Implications: These projects are directed towards conservation of a depleting resource — natural gas. Realization of potential savings in Alberta could equal the combined natural gas needs of the cities of Red Deer, Medicine Hat and Grande Prairie.

Publications: Colley, D.G.; Ritter, R.A.; and Hensley, R.E. *Recuperative Heat Exchange Incinerator Pilot Plant.* Calgary: Bow Valley Research Ltd., October, 1981.

HELIUM RECOVERY FROM NATURAL GAS

Contractor: Alberta Helium Limited, Calgary

Expenditures:

1981-82	$ 163 702
Total to Date	$ 3 189 044

Objectives: To investigate the technical and economic feasibility of new and less energy-intensive technology for the recovery of helium from Alberta natural gas.

Results: The pilot plant operation, which was completed during the year, demonstrated the technical feasibility of recovering helium from Alberta natural gases by membrane permeation. The preliminary design of a commercial permeation plant was developed, based on pilot plant data. In the course of this research, extensive knowledge of the permeation process has been acquired.

Implications: A system has been developed to process pipeline gases and remove the helium. The new system is less costly and consumes less energy to obtain equivalent volumes of helium. Thus, the helium resources of the province may become the source of supply for Canada's future helium requirements and possibly for export. The membrane technology developed has applications in the separation of other industrial gases.

SOLAR AND WIND ENERGY RESEARCH PROGRAM

Contractor: Alberta Research Council, Edmonton

Expenditures:

1981 82	$ 334 809
Total to Date	$ 1 573 307

Objectives: To assess Alberta's solar and wind energy resources using sophisticated instrumentation at strategic locations throughout the province; to upgrade and expand library and technical information services on these resources and on solar and wind energy utilization relevant to the western Canadian climate.

Results: The Solar and Wind Energy Research Program (SWERP) Information Centre responded to an increasing number of information requests. A substantial bibliographic collection is available in the Centre or by inter-library loan, and is accessible by computer.

All of the data gathered to date from the SWERP monitoring network has been analyzed. Modifications to the monitoring equipment were successful in eliminating technical malfunctions, and data collection is continuing.

Implications: Information that was once scattered and difficult to find is now in one location, providing efficient and convenient access to both Canadian and international literature on solar and wind energy. Detailed climatic data will be available for solar and wind energy resource assessment as well as for research and design purposes.

ENERGY RESOURCES DATA SYSTEM

Contractor: Energy Resources Conservation Board, Calgary

Expenditures:

1981 82	$ 1 420 229
Total to Date	$ 3 600 000

Objectives: To consolidate, improve, and expand the existing computer files of the Energy Resources Conservation Board (ERCB) on crude oil, natural gas, coal, and oil sands; to develop a user-oriented data management system to capture, store, and secure the data, and make it more accessible to government and the private sector.

Results: The system is being developed in six stages. Each stage will add data and system capabilities to improve access by industry and government users. Stage 1 was described in the Alberta Canada Energy Resources Research Fund's (A CERRF) Fifth Annual Report. Stage 2 was completed in July 1981. It provided the ERCB with improved access to oil and gas well data as well as with limited access to additional data for industry and government users. Stages 3 and 4 will be initiated in April 1982. All systems within Stages 3 and 4 are expected to be completed by June 1983. They will enhance the accessibility, accuracy, timeliness, and adequacy of data currently available from the ERCB.

No further funding under the A CERRF program is planned. It is intended to complete the system development and data input through ERCB funding.

Implications: With this system, the private sector and government departments and agencies can more efficiently plan their programs involving assessment, exploration, and extraction of Alberta's energy resources.

INSULATION PROPERTIES OF FLAT BUILT-UP ROOFS

Contractor: Alberta Roofing Contractors Association Ltd., Calgary

Expenditures:

1981/82	$ 8 176
Total to Date	$ 47 957

Objectives: To improve the thermal quality of flat built-up roofs on industrial and commercial buildings without adding significant weight to the structures.

Results: The project has been completed. Findings show that retrofit of rigid foam or foamed-in-place insulation to existing roof membranes is possible. These methods do not appear to be cost-effective at today's energy prices.

Implications: While the addition of insulation to existing roof membranes or commercial buildings is technically feasible, it is unlikely to occur on a large scale.

DISTRICT HEATING STUDY (EDMONTON)

Contractor: City of Edmonton

Expenditures:

1981 82	$ (6 600)*
Total to Date	$ 93 400

Objectives: To determine the technical feasibility of using waste heat from the Rossdale Generating Station to provide district heating in downtown Edmonton buildings.

Results: Project results are reported in the A CERRF Fifth Annual Report.

* Brackets indicate that the project was credited by this amount for accrued interest.

HYDROCARBON RESEARCH

Contractor: Hydrocarbon Research Centre Inc., University of Alberta, Edmonton

Expenditures:

1981 82	$ 207 384
Total to Date	$ 890 384

Objectives: To encourage fundamental studies into the formation and composition of Alberta's fossil fuel resources.

Results: Three projects are currently in progress:

S.M. Farouq Ali: "Chemical Flooding Process for Light Oil Reservoirs".

The development of emulsions suitable for the chemical flooding process to enhance oil recovery has reached the stage at which the emulsions may be lab-tested using cores from reservoirs.

L. Plitt and B.C. Flintoff: "Mathematical Modelling of Auto-Medium Cyclones".

Coal beneficiation studies using auto-medium cyclones for cleaning coal fines established parameters controlling cyclone performance. The development of a suitable mathematical model is in progress.

O.P. Strausz: "Chemical Stabilization of Polar Fractions of Petroleum for Study by Field Ionization Mass Spectrometry".

The development of new analytical techniques for conducting chemical studies of Alberta's fossil fuel resources by field ionization mass spectrometry has led to the discovery of a new class of biological markers that extends to the Jurassic period.

Implications: A fundamental understanding of the chemistry of the asphaltenes, bitumen and coal, and of the technology in these diverse areas, should assist the exploration, recovery, upgrading and utilization of these resources.

ENERGY RESOURCES RESEARCH BUILDING (CALGARY)

Contractor: Alberta Housing and Public Works, Calgary

Expenditures:

1981 82	$ 213 812
Total to Date	$ 3 214 724

Objectives: To construct a facility for energy-related research in Calgary.

Results: The project has been completed. The principal occupants (Petroleum Recovery Institute, Computer Modelling Group, Canadian Energy Research Institute, and Alberta Research Council) are in the building and their research programs are well under way.

ENERGY RESOURCES RESEARCH BUILDING (DEVON)

Contractor: Alberta Housing and Public Works, Edmonton

Expenditures

1981 82	$ 995 674
Total to Date	$ 1 307 618

Objectives: To construct a facility for the coal-related research activities of the Alberta Research Council, the Coal Mining Research Centre and the Canada Centre for Mineral and Energy Technology (CANMET) Western Research Laboratory.

Results: The design of the pilot plant component of the facility was completed and construction was begun. The conceptual design of the laboratory office complex and of the high head lab was finalized. Working drawings are being prepared, leading to a call for tenders on the balance of the building.

Implications: It is expected that provision of this facility for coal research groups in Alberta will encourage close co-operation between them and lead to the sharing of technical resources.

COAL RESEARCH PROGRAM

Contractor: Alberta Research Council, Edmonton

Expenditures:

1981/82	$ 3 135 406
Total to Date	$ 4 355 190

Objectives: To expand the Alberta Research Council's research on the evaluation of Alberta subbituminous coals in hydroliquefaction and pyrolysis processes. These processes are potential means of producing marketable synthetic fuels from the large coal deposits in the Alberta plains.

Results: A coal sample bank was established, with bulk samples from six of the nine major coal deposits in the Alberta plains. Autoclave liquefaction tests were completed with three reference coals under conditions representative of five known process types. Samples were also sent for evaluation at centres in the United States and Japan. The autoclave results, together with chemical and petrographic analyses of coal and liquefaction products, provided information on the liquefaction behaviour of these Alberta coals compared with European, North American, Japanese and Australian coals. Promising process conditions and adaptations have been identified. Detailed evaluation of these conditions will be conducted on the semi-continuous unit and the continuous bench unit now being constructed at the new pilot plant facilities at Nisku.

In addition, laboratory assays of coal samples from selected regions have been carried out to provide preliminary information on liquid yields from flash pyrolysis and flash hydropyrolysis processes. Samples were also sent to Occidental Research Corporation in Irvine, California, and to Cities Service Research and Development Company in Tulsa, Oklahoma for evaluation. The results obtained, together with chemical and petrographic analyses of the char produced, have provided information on the pyrolysis behaviour of Alberta coals.

Implications: Systematic research on, and development of, liquefaction and pyrolysis will provide information needed to evaluate, adapt and improve processes for converting indigenous coals to marketable products.

Publications:

Campbell, J. *Subbituminous Coal Regions in Alberta — Potential for Coal Conversion.* Edmonton: Alberta Research Council, 1981. (Internal Report No. YCLQ-2)

Carson, D; Gawlak, M.; and Ignasiak, B. "Solubilization of Coal by Reductive and Non-Reductive Alkylation in Liquid Ammonia". *Proceedings of the International Conference on Coal Science.* Duesseldorf: September 1981.

Chakrabartty, S. (1981) "Oxidation of Coal: A Mechanistic Puzzle". American Chemical Society, Division of Fuel Chemistry Pre-print 26:1:10.

du Plessis, M.P. "Coal Utilization Trends in Alberta." *Proceedings of the 64th CIC Coal Symposium.* Halifax: May 1981.

Gawlak, M.; Cyr, N.; Carson, D.; and Ignasiak, B. "Speculation on Molecular Environment of Reactive Hydrogen Atoms in Coal". Paper presented at the 64th CIC Coal Symposium. Halifax: May 1981.

Ignasiak, B. "A Novel Method for Metallurgical Coke Production". *Proceedings of the 2nd World Congress of Chemical Engineering.* Montreal: October 1981.

Ignasiak, B.; Carson, D.; Gawlak, M.; and du Plessis, M.P. "Comparative Studies on the Liquefaction and Solubilization Reactivity of Subbituminous and Bituminous Coals". *Proceedings of the 64th CIC Coal Symposium.* Halifax: May 1981.

Kotanigawa, T.; Chakrabartty, S.K.; and Berkowitz, N. "Behaviour of Iron Catalyst on Hydrocarbon Synthesis from Carbon Monoxide and Steam". *Fuel Processing Technology* 5:79-80

Moschopedis, S.E.; and Hawkins, R.W. "Use of Synthesis in CO-Processing of Coal-Bitumen and Derivatives". *Fuel* 60 (1981): 1170.

_____. *Fractionation of Oil Sands Bitumen and Coal-Derived Liquids.* Edmonton: Alberta Research Council, 1981. (ARC Information Series No. 94)

Moschopedis, S.E.; Hawkins, R.W.; and Speight, J.G. (1981) "Investigation in the Use of Heavy Oils (and Derivatives) to Process Coal". American Chemical Society, Division of Fuel Chemistry Pre-print 26:3:131.

_____. (1981) "The Identification of Nitrogen Functional Groups in Athabasca bitumen". *Fuel* 60: 297.

Moschopedis, S.E.; Hawkins, R.W.; and Wasylyk, H. *Batch Autoclave Tests for the Liquefaction of Alberta Subbituminous Coals: I.G. Farben Liquefaction Process.* Edmonton: Alberta Research Council, 1981. (Internal Report No. YCLQ-5)

Ozum, B. *A Study on the Kilborn Report, Coal Liquefaction Plant Feasibility Studies.* Edmonton: Alberta Research Council, 1982. (Internal Report No. YCLQ-8)

Parkash, S. (1981) "Determination of Active Metal Sites in Metal Oxide Catalysts by Selective Gas Chemisorption". *Canadian Journal of Chemical Engineering* 60:23.

_____. "Changes in the Physical Properties of Coal on Partial Solubilization". *Proceedings of the 15th Biennial Conference on Carbon.* Philadelphia: June 1981.

_____. "Some Scientific Considerations for Catalyst Preparation". *Proceedings of the 28th Congress of the Union of Pure and Applied Chemistry.* Vancouver: August 1981.

_____. "Search and Selection of Catalysts for Coal Liquefaction". *Proceedings of the 2nd World Congress of Chemical Engineering.* Montreal: October 1981.

_____. "Petrographic Composition and Liquefaction Behaviour of Lignites". Paper presented at the Canadian Coal Petrographics Annual Meeting. Regina: November 1981.

Parkash, S.; Carson, D.; and Ignasiak, B. *Petrographic Composition and Liquefaction Behavior of Lignites from North Dakota and Texas, U.S.A.* Edmonton: Alberta Research Council, 1981. (Internal Report No. YCLQ-3)

Parkash, S.; Kotanigawa, T.; and Chakrabartty, S. "Changes in Pore Structure of Precipitated Iron Oxide Catalysts". *Fuel Processing Technology* 5:203-221, January 1982.

Parkash, S.; Stangl, C.; and Holuszko, M. *Round Robin Test — 1982: Petrographic Analysis for a High Volatile Australian Coal and Its Liquefied Residue.* Edmonton: Alberta Research Council, March 1982. (Internal Report No. YCLQ-10)

Schulz, K.F.; and Selucky, M.L. (1981) "E.S.R. Measurements on Asphaltene and Resin Fractions from Various Separation Methods". *Fuel* 60:951.

Selucky, M.L. "Significance of Chromatographic Separations for Structural Studies of Asphaltenes and Resins". Paper presented at the Heavy Oils Symposium. Salt Lake City: October 1981.

Selucky, M.L.; Kim, S.S.; Skinner, F.; and Strausz, O.P. (1981) "Structure Related Properties of Athabasca Asphaltenes and Resins as Indicated by Chromatographic Separation". *Chemistry of Asphaltenes,* Advances in Chemistry Series 195:83-118.

Speight, J.G.; and Moschopedis, S.E. (1981) "Anomalous Effects in the Character of the Carbonyl Absorption (ca. 1700 cm^{-1}) in the Infrared Spectra of Petroleum Resins and Asphaltenes". Pre-print by the American Chemical Society, Division of Petroleum Chemistry, Inc. 26:3:907.

STREAMLINE DEVICE FOR TRANSPORT TRUCKS

Contractor: Nahanni Industries, Edmonton

Expenditures:

1981 82	$ 2 256
Total to Date	$ 8 916

Objectives: To investigate the feasibility of improving the aerodynamic properties of large highway vehicles by streamlining the trailing edge of such vehicles using a light add-on device to reduce drag.

Results: Initial road tests under normal operating conditions were disappointing. Conclusive improvements and fuel savings could not be identified for truck-trailers with an attached tail cone versus standard truck-trailers. The tests contradicted theory and wind-tunnel tests.

Additional tests under fixed conditions (e.g. eliminating driver variables), however, were conducted, showing positive results. Fuel savings in the order of six percent were accomplished. Results clearly indicate the important effects of operator practices.

The project is completed.

Implications: Add-on aerodynamic devices to large truck-trailers have potential for energy savings; however, driver practices and vehicle conditions can easily nullify these gains. Significant savings, therefore, require an integral approach, including improvement of the aerodynamic design, governing of engine rpm, selection of optimal rear-axle ratios, continued performance information to the driver and comprehensive driver training.

CATALYST EVALUATION IN AN INDUSTRIAL CLAUS PROCESS TEST REACTOR

Contractor: Canadian Gas Processors Research Fund, Calgary, and University of Alberta, Edmonton

Expenditures:

1981/82	$ 11 157
Total to Date	$ 36 323

Objectives: To test in the field a novel Claus process catalyst developed with funding from the Canadian Gas Processors Research Fund (CGPRF).

Results: Both novel and industrial bauxite catalysts were tested. Over approximately three months of operation, the novel catalyst exhibited superior performance for the conversion of hydrogen sulphide sulphur dioxide and carbon disulphide to hydrogen sulphide and comparable performance for conversion of carbonyl sulphide to hydrogen sulphide. These performances occurred at temperatures 20° below those in a comparable first-stage plant reactor.

Implications: Improved catalysts are expected to give higher conversions of sulphur compounds in natural gas processing plants resulting in reduced emissions.

SUPERIOR POLYMERS FOR ENHANCED OIL RECOVERY

Contractor: Raylo Chemicals, Edmonton

Expenditures:

1981/82	$ 34 654
Total to Date	$ 186 895

Objectives: To evaluate existing polymers used for enhanced oil recovery and to develop polymers with superior properties.

Results: A method for rapid assessment of the effectiveness of potential stabilizers to prevent or reduce polymer degradation was developed. Chemical post-modification of natural and synthetic water-soluble polymers was initiated. Grafting of polyacrylamide to a polysaccaride backbone is expected to yield a product resistant to shear degradation. Although substantial research is still required, the project was terminated by mutual agreement and a final report is being prepared.

Implications: Initial established reserves of crude oil recoverable in Alberta are 1.9 billion cubic metres (12 billion barrels). Using enhanced oil recovery (EOR) techniques, an additional 382 million cubic metres (2.4 billion barrels) are expected to be recoverable. Of this, it is estimated that polymer-based processes will be responsible for the recovery of approximately 19 million cubic metres (120 million barrels). The improvements in the formulation of polymers to make them more shear- and chemical-resistant may increase the amount of recoverable oil.

ENERGY-EFFICIENT HOUSING DISPLAY PROGRAM

Contractor: Housing and Urban Development Association of Canada, Alberta Council, Edmonton

Expenditures:

1981 82	$ 221 332
Total to Date	$ 221 332

Objectives:

1) To develop energy-efficient housing designs and related construction procedures;

2) to stimulate development by builders and manufacturers of energy-efficient and cost-effective construction techniques and materials;

3) to stimulate an awareness within the residential construction industry of the need for more emphasis on energy conservation; and

4) to develop and construct housing models for public viewing and education that use energy-efficient designs and construction methods.

Results: Ten homes with upgraded thermal efficiency were constructed, five each in Edmonton and Calgary. All were open to the public for six weeks as part of the HUDAC Home Parade in each city.

The project successfully showed that home builders are interested in energy conservation and are willing to become involved in a search for novel construction technologies and methods. It also showed that some energy-saving techniques could be incorporated immediately but that others are difficult to sell to the general public in current economic times.

Implications: It is expected that home heating requirements will constitute 20 to 25 percent of Alberta's energy expenditure over the next decade. The continuing education of both the public and the housing industry about the benefits of energy efficiency must be considered an investment, in view of the profound long-term effects these benefits can have on efficient energy utilization.

PASSIVE SOLAR-HEATED COMMUNITY CENTRE

Contractor: Anzac Citizens Association, Anzac and Sunergy Systems Ltd., Carstairs

Expenditures:

1981 82	$ 10 120
Total to Date	$ 12 170

Objectives: To design a community centre in Anzac, near Fort McMurray, employing passive solar techniques which emphasize energy-efficient features, and using local materials.

Results: The design of a small community centre for Anzac has been completed, incorporating many energy-efficient features such as direct solar gain, sunspace systems connected to mass storage, and utilization of on-site construction materials.

Implications: The design and construction of energy-efficient, yet low-cost public buildings would help northern communities save on costs of conventional fossil fuels for space heating.

DEVELOPMENT OF LARGE DELTA-BLADE WIND TURBINES

Contractor: ABAX Energy Services Ltd., Calgary

Expenditures:

1981 82	$ 92 945
Total to Date	$ 92 945

Objectives: To prove the design, performance, reliability and economics of the delta-blade wind turbine system for application to a variety of direct water-pumping uses.

Results: The preliminary design confirms the delta turbine pumping concept to be technically feasible. The entire machine can be manufactured in Alberta from basic, readily available materials. Its slow operating speed promises long service life with a low level of maintenance.

The calculated power outputs of the delta turbine compare favourably with those indicated by other wind-energy systems of comparable size, and its operating reliability should be high, as sophisticated control systems are not required.

A broad potential market has been identified for turbines of various sizes. The turbines could be used for direct water-pumping, particularly in conjunction with water storage and for recycling water for hydro-electric power generation.

For new installations, the preliminary analysis indicates the delta turbine system to be economical compared with conventional energy alternatives such as diesel, liquefied petroleum gases (LPG), natural gas-fuelled engine systems or electrically driven pumps. Its economic viability would be considerably greater for year-round pumping applications.

Implications: The delta turbine system appears to be a strong competitor in the development of wind energy, both in Alberta and in other regions of the continent. Aside from contributing to conservation of conventional energy, the delta turbine offers good potential for extensive use in the expansion of irrigation, water systems and energy systems, and for the development of manufacturing in Alberta.

COMPARISON STUDY OF WIND TURBINES

Contractor: The DALCOR Group, Edmonton

Expenditures:

1981 82	$ 10 686
Total to Date	$ 10 686

Objectives: To conduct a technical and economic analysis to compare different approaches in the utilization of wind turbines for the purpose of water pumping in irrigation systems in southern Alberta.

Results: The study comparing relative unit costs of energy for different wind turbines was completed. The results indicate that a delta-blade wind turbine using a variable-speed pump for pumping water during the irrigation season may be competitive with wind turbine electric generators combined with electric pumps.

Implications: Further development of the delta-blade wind turbine system appears warranted.

ENERGY-EFFICIENT MASONRY FIREPLACES

Contractor: Centre for Research and Development in Masonry, Calgary

Expenditures:

1981 82	$ Nil
Total to Date	$ Nil

Objectives: To measure the performance characteristic of two modified designs of masonry fireplaces and to develop a method for rating the efficiency of fireplaces.

Results: Project has been approved and work commenced April 1, 1982.

Implications: Modified designs of the popular masonry fireplaces could lead to energy savings.

FINANCIAL STATEMENT

SUMMARY OF EXPENDITURES

Pursuant to the terms of the November 1976 Agreement between the Prime Minister of Canada and the Premier of Alberta, a sum of $72 million was transferred to Alberta by March 31, 1981, and in the fiscal year ending March 31, 1982, a sum of $24 million was transferred.

Funds transferred to the province are deposited to the General Revenue Account, Alberta Treasury, and are subsequently made available to projects approved by the Alberta Canada Committee by special warrants authorizing expenditures through the appropriations of Alberta Energy and Natural Resources. From April 1, 1981 to March 31, 1982, the amounts shown in the associated table were transferred to, and expended by, the approved projects.

The total expenditures on approved projects from the beginning of the program to March 31, 1982 totalled $29 703 603.

Summary of Transfers To and Expenditures By Approved Projects from April 1, 1981 to March 31, 1982

Project	Balance Brought Forward From 1980/81	Transferred[1]	Spent[2]	Balance[3]
1 Enhanced Recovery of Conventional Crude Oil	$ 18 539	$ 531 461	$ 550 000	$ Nil
2 Computer Modelling Technology	Nil	300 000	300 000	Nil
3 Coal Mining Research	(4 650)	1 022 000	837 722	179 628
4 Alberta Universities Program	6 132	678 111	619 023	65 220
5 Energy Conservation in Sour Gas Processing	Nil	209 532	209 532	Nil
6 Helium Recovery From Natural Gas	53 676	115 000	163 702	4 974
7 Solar and Wind Energy Research Program	(41 030)	358 177	334 809	(17 662)
8 Energy Resources Data System	21 126	1 399 103	1 420 229	Nil
9 Insulation Properties of Flat Built-Up Roofs	8 219	Nil	8 176	43
10 District Heating Study (Edmonton)	(15 000)	8 400	(6 600)[4]	Nil
11 Hydrocarbon Research	350 000	350 000	207 384	492 616
12 Energy Resources Research Building (Calgary)	Nil	213 812	213 812	Nil
13 Energy Resources Research Building (Devon)	Nil	995 674	995 674	Nil
14 Coal Research Program	Nil	2 925 000	3 135 406	(210 406)
15 Streamline Device for Transport Trucks	(666)	2 922	2 256	Nil
16 Catalyst Evaluation in an Industrial Claus Process Test Reactor	6 134	15 023	11 157	10 000
17 Superior Polymers for Enhanced Oil Recovery	(13 531)	43 150	34 654	(5 035)
18 Energy-Efficient Housing Display Program	30 000	186 000	221 332	(5 332)
19 Passive Solar-Heated Community Centre	2 950	7 170	10 120	Nil
20 Development of Large Delta-Blade Wind Turbines	Nil	92 945	92 945	Nil
21 Comparison Study of Wind Turbines	Nil	11 073	10 686	387
22 Energy-Efficient Masonry Fireplaces	Nil	Nil	Nil	Nil
Subtotal	421 899	9 464 553	9 372 019	514 433
Administration	Nil	121 640	121 640	Nil
Total	421 899	9 586 193	9 493 659	514 433

[1] Refers to funds transferred by the Department of Energy and Natural Resources to contractors for application to projects in accordance with signed agreements. This includes funds totalling $1 160 500 transferred from 1980/81 Special Warrant to projects 1, 2, 3, 5, 6, 17, 18, and 19 as an advance against First Quarter 1981/82 project expenditures. This does not include funds totalling $810 000 transferred from 1981/82 Special Warrant to projects 1, 2, 3, and 22 as an advance against First Quarter 1982/83 projected expenditures.

[2] Refers to project expenditure by contractors which were funded by ERRF transfers. Interest and other revenues amounting to $37 313 have not been included in [1] and expenditures have been reduced by the same amount.

[3] Refers to balance of ERRF funds with contractors at March 31, 1982.

[4] Credit arises from accrued interest reported for the 1981-82 fiscal year (see note [2]).

POOR

QUALITY

ORIGINAL